

The most recent burst of Star Formation in the Massive Elliptical Galaxy NGC 1052^{*}

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ABSTRACT

High-spatial resolution near-infrared (NIR) images of the central 24×24 arcsec² ($\sim 2 \times 2$ kpc²) of the elliptical galaxy NGC 1052 reveal a total of 25 compact sources randomly distributed in the region. Fifteen of them exhibit H α luminosities an order of magnitude above the estimate for an evolved population of extreme horizontal branch stars. Their H α equivalent widths and optical-to-NIR spectral energy distributions are consistent with them being young stellar clusters aged < 7 Myr. We consider this to be the first direct observation of spatially resolved star-forming regions in the central kiloparsecs of an elliptical galaxy. The sizes of these regions are $\lesssim 11$ pc and their median reddening is $E(B - V) \sim 1$ mag. According to previous works, NGC 1052 may have experienced a merger event about 1 Gyr ago. On the assumption that these clusters are spreaded with similar density over the whole galaxy, the fraction of galaxy mass (5×10^{-5}) and rate of star formation ($0.01 M_{\odot} \text{ yr}^{-1}$) involved, suggest the merger event as the possible cause for the star formation we see today.

Key words: galaxies: individual: NGC 1052 – galaxies: interactions – galaxies: nuclei – galaxies: star clusters – techniques: high angular resolution.

1 INTRODUCTION

About $\sim 30\%$ of the local early-type galaxies present signs of Recent Star Formation (RSF) in the last Gyr (Kaviraj et al. 2007). This result arises from the study of the integrated UV–optical colours of a large sample of early-type galaxies. A sizeable fraction of objects are revealed by their blue colours, $NUV-r < 5.5$ mag, despite of the fact that their optical colours place them in the optical “red sequence” ($u - r > 2.2$ mag, Strateva et al. 2001). Given these blue $NUV-r$ colours, a merger is likely the origin of the induced RSF (Kaviraj et al. 2009; Kaviraj 2010; López-Sanjuan et al. 2010).

In that scenario, one would expect the formation of new young cluster populations in an elliptical galaxy which presents blue UV–optical colours and a past merger event (Kaviraj 2010). However, most of the examples reported up to date exhibit intermediate-age clusters, between $\gtrsim 200$ Myr and a few Gyr (e.g. NGC 1316, NGC 1380, NGC 1700, NGC 3610, NGC 5128 Carlson et al. 1999; Goudfroi et al. 2001; Williams et al. 2010). In those cases, most of the age estimates are based on the comparison of cluster colours with stellar population models, and thus are strongly dependent

on the metallicity, extinction and IMF assumed in these models. Therefore, a scrutinized study of nearby ellipticals with blue UV–optical colours is particularly interesting to reveal the young cluster population at the earliest stage of their evolution, i.e. $\lesssim 10$ Myr. It is in this context that this letter is addressed. It presents the first detection of individually resolved young stellar clusters, $\lesssim 7$ Myr old, in a nearby elliptical galaxy, NGC 1052. To single out this population, high spatial resolution imaging from UV to optical and infrared (IR) are used. A complete spectral energy distribution (SED) is built for each of the clusters, their nature, ages and dust estimates have been addressed on the basis of their H α emission.

NGC 1052 is one of the nearest elliptical galaxies (E4, 18 Mpc, $1'' \approx 87$ pc, Jensen et al. 2003) with a stellar mass of $M_{*} \approx 10^{11} M_{\odot}$ (derived from 2MASS¹ photometry, assuming $M_{*}/L_K = 1.32 M_{\odot}/L_{\odot}$, Cole et al. 2001) and a low-level activity LINER nucleus (Heckman 1980). It presents two radio lobes (Cooper et al. 2007, Fig. 1) and a collimated ionized gas structure in H α +[N II] (Pogge et al. 2000), both extended in the east–west direction, and a parsec-scale twin jet (PA $\sim 60^{\circ}$) with an emission gap between the brightest part located north-east (NE) and the counter jet in the south-west (SW) direction (Kadler et al. 2004).

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¹ 2 Micron All Sky Survey, see <http://www.ipac.caltech.edu/2mass/>

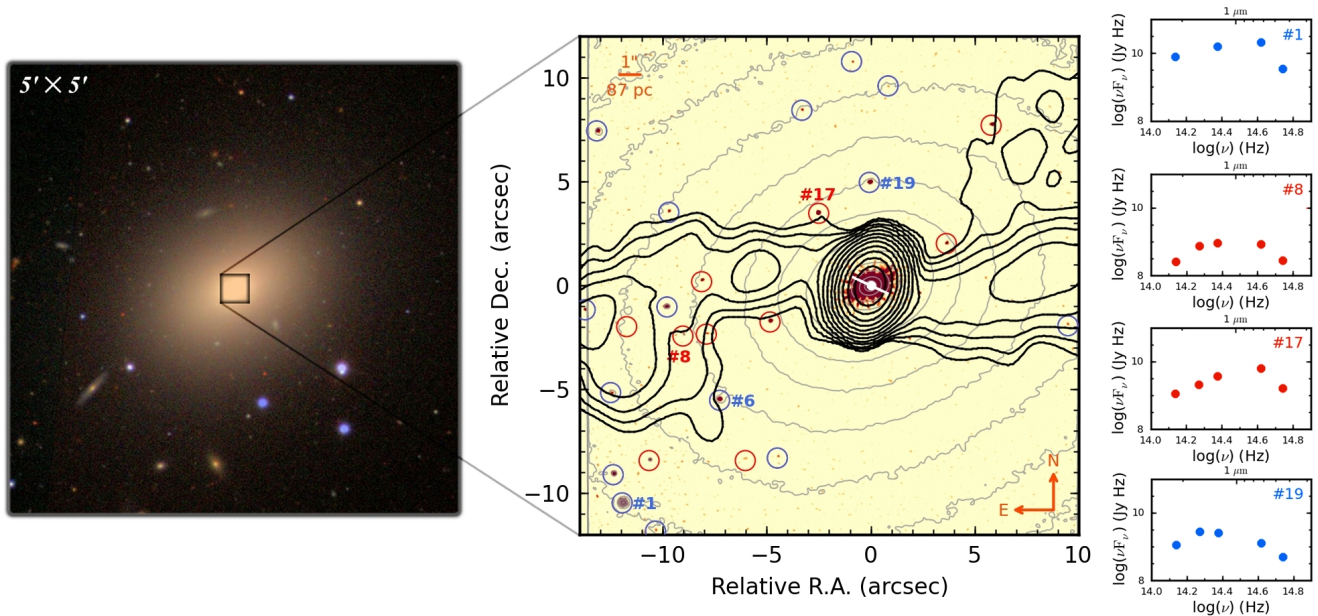


Figure 1. *Left:* SDSS *g* (blue), *r* (green) and *i*-band (red) colour composite image for NGC 1052. VLT/NaCo $24 \times 24 \text{ arcsec}^2$ FOV is marked by a black square. *Centre:* Unsharp-masked VLT/NaCo *Ks*-band image, logarithmic contours for the natural *Ks*-band image (grey colour) and VLA contours at 1.4 GHz (black, beam $\sim 2'' \times 1''.5$, Cooper et al. 2007). In blue, knots with $\text{EW}_{H\alpha} \geq 50 \text{ \AA}$, in red those with $< 50 \text{ \AA}$. The central white barred-dot marks the position of the nucleus and the direction of the parsec-scale twin jet. *Right:* SEDs for two “blue” (#1 and #19) and two “red” knots (#8 and #17).

The radio lobes are also spatially coincident with the X-ray emission region reported by Kadler et al. (2004). The distribution of the H I gas, with two tidal tails extended from NE to SW and also an infalling component, is interpreted as evidence of a merger event about 1 Gyr ago (van Gorkom et al. 1986, 1989). This scenario is further supported by the different rotation axes found for the gas and the stars (Plana & Boulesteix 1996) and by the presence of dust lanes along the N–S direction near the galaxy centre (Forbes et al. 1990). Furthermore, NGC 1052 shows typical integrated colours of a “rejuvenated” early-type galaxy (following Kaviraj et al. 2007), having $NUV-r = 4.9 \text{ mag}$, while the $u-r = 2.8 \text{ mag}$ colour places this galaxy in the optical red sequence (NUV from Ramazzo et al. 2007; u and r -band from SDSS²).

2 OBSERVATIONS

The brightness of the LINER nucleus permitted us to perform high-spatial resolution observations using the Very Large Telescope (VLT) and the Nasmyth Adaptive Optics System (NAOS) plus the Near-Infrared Imager and Spectrograph (CONICA). The VLT/NaCo dataset consist of near-infrared (NIR) *J*, *Ks* and *L'*-band observations for the central $24 \times 24 \text{ arcsec}^2$ of NGC 1052 ($\sim 2 \times 2 \text{ kpc}^2$, Fig. 1), taken on 2005 December 3. The total exposure times are 900 s (*J*), 400 s (*Ks*) and 5.25 s (*L'*), and the achieved FWHM resolution –measured in the most compact objects in these images– are $\lesssim 0''.26$, $\lesssim 0''.12$ and $\lesssim 0''.12$, respectively. Data reduction of the NaCo dataset was performed using the ECLIPSE package, provided by ESO, and includes sky subtraction, registration and combination of frames to obtain a final image per filter. The photometric calibration was based on standard stars taken along with the science frames.

The relative photometric error is $\sim 8\%$, $\sim 11\%$ and $\sim 11\%$ in the *J*, *Ks* and *L'*-bands, respectively. The VLT/NaCo dataset was complemented with the following *Hubble Space Telescope* (*HST*) imaging: WFPC/F555W (Wide Field Planetary Camera/V-band, $\lambda 0.55 \mu\text{m}$ $\Delta\lambda 0.05 \mu\text{m}$), WFPC2/F658N (including $H\alpha + [\text{N II}]$, $\lambda 0.659 \mu\text{m}$ $\Delta\lambda 0.003 \mu\text{m}$), STIS/F28X50LP (Space Telescope Imaging Spectrograph, $\lambda 0.72 \mu\text{m}$ $\Delta\lambda 0.11 \mu\text{m}$) and NICMOS/F160W (Near-Infrared Camera and Multi-Object Spectrometer/*H*-band, $\lambda 1.61 \mu\text{m}$ $\Delta\lambda 0.12 \mu\text{m}$). The reduced images were retrieved directly from the scientific archive, and the photometric calibration was performed by using the PHOTFLAMB keyword value in the image header as a conversion factor.

Image alignment of the whole set is based on the identification of two compact sources (knots) seen in all filters but in the *L'*-band. We avoided using the nucleus since dust obscuration may distort its position in the optical. For the *L'*-band, we assumed its position to match that in the *Ks*-band. We further used a 1.4 GHz image with a beam resolution of $\sim 2'' \times 1''.5$ from VLA (Cooper et al. 2007). The signal-to-noise achieved in the NaCo *J* and *Ks*-bands permitted us to distinguish a number of point-like sources in the FOV. In order to enhance the image contrast, different techniques were applied, the best results being obtained by the unsharp-masking method (Sofue 1993). A median circular filter with radius $0''.12$ was used to smooth the images, which were then subtracted from the original ones. The result for the *Ks*-band is shown in the background of Fig. 1. The DAOPHOT finding algorithm (Stetson 1987) recovered, on the *J* and *Ks* unsharp-masked images, a total of 25 point-like sources over a 3σ threshold in the central $24 \times 24 \text{ arcsec}^2$ (circles in Fig. 1). None of these knots are detected in the UV images from *HST*/ACS (Advance Camera for Surveys), acquired with F250W and F330W filters and taken also from the scientific archive. The wider FOV of STIS image ($\sim 28 \times 51 \text{ arcsec}^2$) shows nearly 70 knots, which seem more dispersed with increasing radius. Counterparts in other bands (F555W,

² Sloan Digital Sky Survey, see <http://www.sdss.org/>

J , K_s , none detected in the L' -band) exist only for the 25 knots in the common FOV. In the H -band 2 of these knots are outside of the NICMOS FOV. The photometry was extracted from a circular aperture ($r_a = \text{FWHM}$ in each filter) centred on a common position for all images. The background emission was then subtracted as the mode value for an annular concentric region ($r_s \sim [0''.4-0''.6]$). Some of these regions stand out in the narrow-band F658N image, centred on $H\alpha + [\text{N II}]$. To estimate the flux in this blend, the continuum contribution was inferred by linear interpolation between the F555W and J broad-band filters. The possible uncertainties derived in the continuum estimation will be discussed later. Finally, the $H\alpha$ flux was then corrected by the $[\text{N II}]$ contribution by assuming that to be 40 per cent of the total (Baldwin et al. 1981).

3 RESULTS

Most of the 25 knots are unresolved or barely resolved with sizes of about $0''.12$ ($\lesssim 10.5$ pc), i.e. the spatial resolution in the VLT/NaCo K_s -band image. They show a median brightness of $m_K = 20.9$ mag, which corresponds to an absolute magnitude of $M_K = -10.4$ mag, too bright for being individual red supergiant stars (Tabur et al. 2009). The knots are distributed in the $-12 \leq M_K \leq -9$ mag range, except knot #1, which is by far the brightest with $M_{K\#1} = -13.6$ mag. In the optical, they are characterized by a median $m_V = 24.3$ mag and $m_I = 22.1$ mag, corresponding to $M_V = -7.0$ mag and $M_I = -9.2$ mag. Most of the 25 knots are strong emitters in $H\alpha$. Moreover, the $H\alpha$ equivalent width ($\text{EW}_{H\alpha}$) distribution shows $\gtrsim 50 \text{ \AA}$ for most of them, we therefore adopted this value as a threshold to separate $H\alpha$ emitting knots from those without $H\alpha$ emission. Assuming these to be star clusters, their ages were derived from their $\text{EW}_{H\alpha}$. STARBURST99 models (Leitherer et al. 1999) were used, assuming an instantaneous burst model with the highest available metallicity, $Z = 0.04$. This follows the results by Pierce et al. (2005) who found higher than solar metallicity abundances ($Z > 0.08$) in the central ~ 10 arcsec (~ 1 kpc) region of NGC 1052 from the analysis of spectral indices measured at various radii in an optical long-slit spectrum. Notice that these are stellar metallicities and not nebular ones. A lower limit for the metallicity will be considered below.

A total of 15 knots were found with $\text{EW}_{H\alpha} \geq 50 \text{ \AA}$ (blue circles in Fig. 1), which yields ages of $\lesssim 6.8$ Myr. Their median $\text{EW}_{H\alpha}$ value is 116 \AA (6.2 Myr), with half of them located in the $105\text{--}175 \text{ \AA}$ range (5.4–6.5 Myr), i.e. the first and third quartiles, respectively. Lower $\text{EW}_{H\alpha}$ for the remaining knots may be due to the clusters being older or to a higher extinction which will affect the $H\alpha$ continuum interpolation. In the conservative side, choosing larger photometric aperture in the F555W and J -bands – the ones used to define the $H\alpha$ continuum flux – decreases the number of knots over the 50 \AA limit to 8, instead of 15. The net effect of considering lower metallicities, e.g. $Z = 0.001$, would translate in older ages for a given $\text{EW}_{H\alpha}$, but values over the 50 \AA threshold still limit the age to ≤ 12.2 Myr. The number of “young” regions just increases to 16 by assuming the $[\text{N II}]$ contribution to be 20 per cent instead of 40 in the $H\alpha + [\text{N II}]$ blend.

The $H\alpha$ luminosity ($L_{H\alpha}$) for the 15 knots with $\text{EW}_{H\alpha} \geq 50 \text{ \AA}$ spans the $[1\text{--}33] \times 10^{36} \text{ erg s}^{-1}$ range. Notwithstanding, ionizing photons may be produced by an old stellar population due to the “UV-upturn” (see O’Connell 1999, and references therein). This additional contribution in the UV range originates in some low-mass, helium-burning stars in the extreme horizontal branch (EHB) and subsequent phases of evolution. In

this scenario, the compact knots in NGC 1052 could be either old globular clusters (GCs) with an EHB component or young stellar clusters probably linked with the merger event occurred in the recent history of this galaxy. A detailed analysis was then performed for knot #6 (Fig. 1), which is representative of the 15 knots’ sample in terms of brightness and SED’s shape. From its $H\alpha$ luminosity ($5.2 \times 10^{36} \text{ erg s}^{-1}$) we derived an ionizing photon rate of $\sim 3.8 \times 10^{48} \text{ ph s}^{-1}$ (Osterbrock 1989, following). This estimate is compared in the next sections with predictions of a SED from an old and a young stellar population, respectively.

3.1 Old globular clusters?

Fig. 2 shows the spectral energy distribution (SED) of the knot #6, which is derived from broad-band photometry (blue dots) including the upper limit in the L -band. First, we show the SED of a 15 Gyr old, $Z = 0.05$ population from Bruzual & Charlot (2003, red line in Fig. 2) scaled to the NIR SED of knot #6 (the NIR SED comprises 3 points: $HST/F160W$, NaCo J and K_s -bands). We choose scaling to the NIR to minimize dust extinction effects. The rate of ionizing photons produced by this population – mainly by blue horizontal branch stars – is then determined by integrating the template below the Lyman limit (shaded area below the red line). This results in $1.2 \times 10^{47} \text{ ph s}^{-1}$, i.e. more than an order of magnitude lower than the value measured for knot #6; thus, the $H\alpha$ emission cannot be explained by this 15 Gyr old population.

However, the EHB component is not included in the 15 Gyr old template. EHB stars present small envelopes around the helium core, showing a hot thermal spectrum with $T \gtrsim 20000 \text{ K}$. The integrated energy distribution of such an old population ($\gtrsim 10$ Gyr) increases shortwards of $\sim 2000 \text{ \AA}$ and is thus capable of emitting FUV photons (Greggio & Renzini 1990). To estimate the possible contribution of these stars we consider the spectrum of the UV-strong elliptical galaxy NGC 4552, which is expected to have an important contribution from EHB stars. For consistency, this spectrum was scaled to the 15 Gyr old template used before in the optical region (yellow line in Fig. 2). Shortwards of 900 \AA , NGC 4552 spectrum was extended with a $T = 35000 \text{ K}$ black body that was scaled to NGC 4552 in the UV part (black-dashed line in Fig. 2). In this case, the integrated number of ionizing photons is $1.8 \times 10^{47} \text{ ph s}^{-1}$, still an order of magnitude below the measured value. It should be noticed that the the measured $H\alpha$ emission in the knots, and thus the ionizing photon rate, may still be an lower limit due to the possible contribution of $H\alpha$ in absorption. This is expected from intermediate-age A-stars population in the clusters.

3.2 Young stellar clusters?

We now consider a young 6 Myr old, $Z = 0.04$ star cluster model from STARBURST99 (blue-solid line in Fig. 2, Leitherer et al. 1999). The model choice is based on the $\text{EW}_{H\alpha}$ of knot #6. Scaling it to the NIR SED region of this knot, the resulting photon rate is $2.5 \times 10^{49} \text{ ph s}^{-1}$. This is more than an order of magnitude larger than the measured value. Moreover, the model largely overestimates the emission in the optical range (see Fig. 2). As dust is expected in the environment of young clusters, different extinction values were applied to this model till matching the observed both SED and $H\alpha$ luminosity. We started with an initial value of $A_V = 2.5$ mag –inferred from the $H\alpha$ ratio between model and observation– and apply it consecutively to the SED. The process of fitting both $H\alpha$ emission and SED shape was

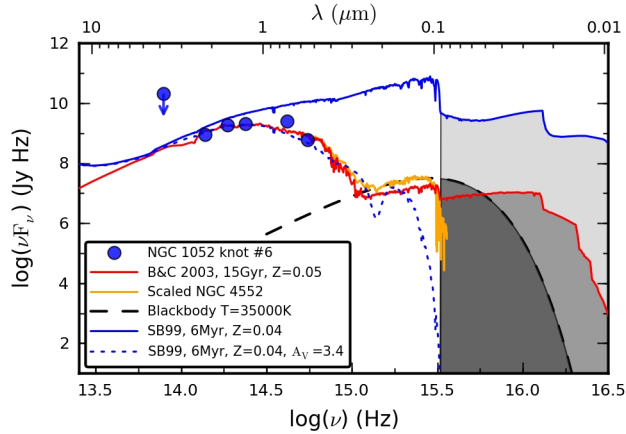


Figure 2. Knot #6 SED (blue circles) compared with a 15 Gyr, $Z = 0.05$ template (Bruzual & Charlot 2003, red line), a composite spectrum of NGC 4552 (Yi et al. 1998, yellow line) plus a blackbody spectrum ($T = 35000$ K, black-dashed line) and a 6 Myr, $Z = 0.04$ template from STARBURST99 (Leitherer et al. 1999, blue-solid line), also shown with an obscuration of $A_V = 3.4$ mag (blue-dotted line). Shaded areas correspond to photons with $\lambda \leq 910$ Å.

done in an iterative manner (using the extinction curve by Cardelli et al. 1989). The best match was found for a model with $A_V = 3.4$ mag (blue-dotted line in Fig. 2), which reproduces the shape of the measured SED. The intrinsic photon rate inferred from the model is 4.9×10^{49} ph s $^{-1}$, $L_{H\alpha} \sim 6.6 \times 10^{37}$ erg s $^{-1}$ and mass $1.3 \times 10^4 M_\odot$ (from Ks-band luminosity, assuming an age- M/L_K dependence from Leitherer et al. 1999). Note that, as we are assuming a foreground dust screen, these values may be lower limits.

3.3 Colours

All the 25 knots look different in brightness and colours with respect to those of the GCs studied in the outer 2–20 kpc of this galaxy by Pierce et al. (2005). The latter present a median $m_V \sim 22.0$ mag with $V - I \sim 0.9$ mag, in contrast with the $V - I = 2.4$ mag³ shown by the former (Fig. 3). Note the *HST*/F28X50LP filter is even bluer than the *I*-band. The differences suggest that both populations are intrinsically distinct. This filter also includes the $H\alpha + [N II]$ blend (~ 0.660 μ m at $z = 0.005$) very close to the transmission peak⁴, but this contribution to the broad-band magnitude (~ 0.3 dex for knot #6) is not enough to explain the large difference in $V - I$ colour. Only knot #1 has a $m_V = 21.9$ mag, compatible with that of the GCs, but its $V - I$ colour is much redder (2.6 mag).

This discrepancy between the two populations cannot be ascribed to the colour bimodality reported by Forbes et al. (2001), since all the GCs in this study lie in the range $1.2 < V - I < 1.7$ mag. On the other hand, an obscuration of $A_V = 3.4$ mag may explain why the knots in the central region look much redder than those of the GCs. Similar extinction values and colours to those shown by the knots have been reported for young stellar clusters (YSCs) in the starbursts galaxies NGC 5253 (Vanzì & Sauvage 2004) and NGC 253 (Fernández-Ontiveros et al. 2009).

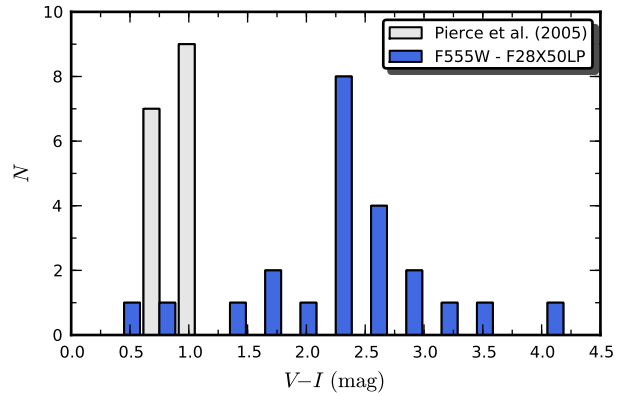


Figure 3. In grey, $V - I$ colours for the GCs in the outer 2–20 kpc of NGC 1052 (Pierce et al. 2005). In blue, the F555W–F28X50LP colour for the 25 knots identified in the central $\sim 2 \times 2$ kpc 2 .

4 DISCUSSION

Recent star formation is found in the centre (2×2 kpc 2) of NGC 1052 in the form of young (~ 6 Myr) and compact (~ 14 pc) stellar clusters with masses of $\sim 10^4 M_\odot$. The age estimation does not depend strongly on the stellar population model assumed. The total star formation rate (SFR) in the centre, derived from the $H\alpha$ luminosity of the 25 knots, is $SFR \sim 7 \times 10^{-4} M_\odot \text{ yr}^{-1}$ (following Kennicutt 1998). Assuming that these clusters are spreaded with similar density over the whole galaxy results in an upper limit for the SFR of $\sim 0.01 M_\odot \text{ yr}^{-1}$. The resulting specific SFR places the galaxy in the “red and death” sequence ($SFR/M_\star \lesssim 10^{-12} \text{ yr}^{-1}$, Fontana et al. 2009). Even if considering the extrapolation for the whole galaxy, the total mass forming these clusters would be less than 5×10^{-3} per cent of the galaxy stellar mass. This suggests that the current RSF is not dominant in the present evolution of NGC 1052.

Several observational signatures indicate that NGC 1052 experienced a merger in the last 1 Gyr (c.f. Introduction). The origin of the knots may be associated with left over activity from that event. Hydrodynamical N -body merger simulations (mass ratio 1:6 to 1:10) by Peirani et al. (2010) suggest that star formation occurs in several bursts after the merger event rather than being a continuous process (see also Kaviraj et al. 2009). This is in agreement with the observations: we find two very young clusters ($EW_{H\alpha} \sim 230$ Å; ~ 5.1 Myr), 4 young ones ($140 \leq EW_{H\alpha} < 200$ Å; 5.2–5.6 Myr), 7 slightly older ones ($90 \leq EW_{H\alpha} < 140$ Å; 5.6–6.6 Myr) and 12 with $EW_{H\alpha} < 90$ Å (> 6.6 Myr). This means that *we are probably looking at either the final stage or a minimum in the star formation activity in the centre induced by a merger event*. In their simulations, Kaviraj et al. (2009) explore extinction values in the $E(B - V) = 0 - 0.5$ mag range, showing that observations favour those models with higher extinction ($E(B - V) \gtrsim 0.3$ mag). For comparison, the colour excess of knot #6 suggests higher values, i.e. $E(B - V) \sim 1.1$ mag ($A_V \sim 3.4$ mag).

Regarding their spatial distribution, the knots with $EW_{H\alpha} \geq 50$ Å are located randomly and do not seem to follow any special pattern except for a weak preference for the NW–SE direction. Moreover, we do not find any clear connection with either the kpc-scale radio lobes at 1.4 GHz (Fig. 1) or with the extended emission in X-rays detected by *Chandra* (Kadler et al. 2004). This indicates that the recent star-formation episode in the centre is not, at least directly, driven by nuclear activity.

The lack of high spatial resolution CO maps does not allow us

³ Strictly speaking, F555W–F28X50LP colour.

⁴ <http://www.stsci.edu/hst/stis/design/filters/>

to connect the knots with density enhancements in the cold material, but the dust lanes in the N–S direction seen in the STIS image are not apparently related with the knots. However, this scattered star formation is in line with the “widespread” star-formation mode found by [Shapiro et al. \(2010\)](#) for early-type galaxies with multiple and mismatched kinematic components. This is the case of NGC 1052, which shows 2 counter-rotating gaseous components decoupled from the stellar kinematics ([Plana & Boulesteix 1996](#)). Furthermore, [Shapiro et al. \(2010\)](#) find that those objects with very low SFRs ($\lesssim 0.06 M_{\odot} \text{ yr}^{-1}$) exhibit a more centralized star-formation activity, which is also favoured by recent simulations ([Peirani et al. 2010](#)). This might explain why [Forbes et al. \(2001\)](#) and [Pierce et al. \(2005\)](#) did not find young clusters in their study, as they covered the outskirts of NGC 1052 (2–20 kpc). Nevertheless, an H α image with a wider FOV is needed to check the young cluster distribution on scales larger than the inner few kpc.

Since we determine the age of the knots on the basis of H α emission, we are only sensitive to very recent star-formation episodes ($\lesssim 10$ Myr) and cannot provide a reliable age for those knots with $\text{EW}_{\text{H}\alpha} < 50 \text{ \AA}$ (10 out of the 25). However, these show very similar properties (i.e. sizes, magnitudes, colours) to those with $\text{EW}_{\text{H}\alpha} > 50 \text{ \AA}$, are also randomly distributed and their SEDs are qualitatively similar (see Fig. 1). Results from stellar population models on the integrated spectrum of the central ~ 1 kpc indicate luminosity-weighted ages of ~ 2 Gyr ([Pierce et al. 2005](#)). However, the contribution of the 25 knots reported in this work is not sufficient to “rejuvenate” the integrated emission of the central region. In line with the scenario proposed by [Shapiro et al. \(2010\)](#), a middle-age population ($10 \text{ Myr} < t < 2 \text{ Gyr}$) is still needed, that would be probably related with a more intense star-formation episode in the past. A spatially resolved spectroscopic study of the central kpc region would be enlightening.

5 FINAL REMARKS

We propose that the knots found in the centre of NGC 1052 are young stellar clusters (YSCs) formed in a very recent star formation episode, probably related with the merger event that occurred ~ 1 Gyr ago ([van Gorkom et al. 1986](#)). This is the first detection of resolved YSCs in the centre of an elliptical galaxy. Their presence has three major implications: *i*) we are looking at the final stage of the RSF occurring in the central parsecs of NGC 1052, *ii*) the RSF takes place in the form of compact and young stellar clusters similar to those found in starburst galaxies, and *iii*) the reddening predicted by young stellar cluster templates [$E(B - V) \sim 1.1 \text{ mag}$] should be explored in future simulations of these systems, which used to assume a lower value as an upper limit.

The case of NGC 1052 is probably one of the best examples for the study of the recent evolution of nearby early-type galaxies via merging with gas-rich satellites. However, high spatial resolution observations in dynamically younger remnants, for which we expect a larger number of YSCs, are desired to understand in detail the role of mergers in the present evolution of elliptical galaxies.

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